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A quality-index of poverty measures

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Abstract

The multitude of available poverty measures can confuse a policy maker who wants to evaluate a poverty-reduction policy. We proposes a rule for ranking poverty measures by use of the food-gap, calculated as the cost-difference between a household's normative food basket, derived from a healthy diet, and the actually chosen food basket. The rationale for this indicator is based on the fact, that (1) basic food needs reflect an ultimate necessity, (2) food expenditure is highly divisibility, thus allowing for efficient marginal substitution between competing necessities when the household's economic hardship increases. For these reasons we believe this to be an objective indicator for the sacrifice in the standard of living of a family under economic stress. A household is identified as 'truly' poor or non-poor by a given poverty measure if the diagnoses coincide and vice versa. The ranking is obtained by a gain-function, which adds up congruent and deducts contradicting outcomes for each poverty measure. We calculate four types of gain-functions –of headcounts, food-gaps, FGT-like powered food-gaps and an augmented version of the latter. The poverty measures include expenditure-based, income-based, relative, absolute, mixed measures and a multidimensional measure of social deprivation. The most qualitative measure is found to be Ravallion's Food Energy Intake and Share measure, though it suffers from a possible bias, since it includes the food-norm in its design. The 60%-median income measure from all sources ranks highest among the unbiased measures. The absolute poverty measure yields the worst performance.

Keywords: poverty measures, food poverty, evaluation of poverty reduction policies
JEL classification codes: I30, I31, I32

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1. Introduction

Poverty research has produced a plethora of definitions of poverty and deprivation, starting from Rowntree's measure of absolute poverty (1901), through measures of relative income poverty, as used by the OECD and the European Union, onward to measures of social deprivation (Runciman, 1972, first ed. 1966, Townsend, 1962, Desai, 1988) and more recently of multidimensional poverty in the spirit of Sen's capability approach (see Sen, 1985; Kakwani and Silber, eds., 2008, Alkire and Foster, 2011).

Competing poverty definitions tend to yield quite different results with respect to the number of the poor and their composition with respect to age, gender and other demographic characteristics based on differences in the identification of the poor.

This state of affairs can confuse the policy makers' decision concerning a suitable poverty measure for targeting and monitoring poverty in their pursuit of an efficient poverty-reduction policy. This is particularly pertinent when resources for poverty reduction programs are scarce, especially in an environment of shrinking GDP shares of taxes and public sector budgets.

This paper develops a ranking system for poverty measures based on an indicator of 'genuine poverty', to be derived independently from specific methods of measuring poverty. 'Genuine poverty' is approximated by a variable measuring the sacrifice of vital food needs. The sacrifice is measured by the difference between the cost of an adequate and healthy food diet and the household's actual expenditure on food. The sacrifice is positive if the actual expenditure falls short of the vital food norm and negative otherwise. We define a gain function which credits a given poverty measure when its predictions of poverty or non-poverty are consistent with the food sacrifice indicator while debiting that function when they are not.

In the spirit of squared gap measures such as the FGT poverty measure we then show that the ranking system can be improved by taking into account the severity of food-poverty as reflected by the squared food-gap.[2] However, unlike in typical poverty analysis, we need to consider scores for both poverty and non-poverty outcomes. We then suggest a more sophisticated quality index, which not only relates to the squared food-gap but also penalizes the quality index for deviations of the given poverty definition's squared gap from the squared food-gap.

[2] See Foster, Greer and Thorbecke, 1984.

Poverty measures such as the absolute (1-$-a-day, 2-$s-a-day) or the half-median equivalized cash-income are one dimensional measures. Other basic-needs oriented consumption baskets, adding an additional dimension of a resource constraint are richer in their information content. Such measures can be calculated from income-expenditure surveys and are thus commonly found in countries' poverty reports.

A more sophisticated approach to poverty measures can be found in the multi-dimensional poverty measurement, based on ideas of Sen's capability approach (1985) and of social deprivation (Townsend, 1962; Runciman, 1972). Such measures combine information on important areas of human functioning, such as health, physical fitness, education, occupation, work and leisure. They reflect not only the aspect of resources but also more general well-being. Such measures are more difficult to measure than those mentioned above.

From the above discussion it becomes evident that the number of possible poverty definitions based on the above classification grows multiplicatively with the specific decisions concerning the poverty calculations: Limiting our choice to the absolute and relative definitions and the one- and two-dimensional space we already get four broad classes of measures (2x2).[3] The arbitrary cutoff rate of one-dimensional poverty measures, sometimes set at 40%, 50% or 60% of the median or average equivalized income or consumption expenditure raise the possible combinations. The multitude of possible measures increases further with the question whether one should base the poverty definition on cash income or rather include other sources of income, for example imputed income from dwelling for home owners. Introducing such issues the number of alternative poverty measures increases rapidly. The major question then becomes how to rank the various poverty measures by use of some quality index, in order to be able to choose among them for use as policy indicators. Such distinctions become particularly worrisome if the results with respect to size, composition and severity of poverty differ significantly among competing definitions, thus making the choice politically loaded. The aim of this analysis is therefore to find an objective ranking procedure that captures the essence of poverty.

The paper is organized as follows:

The sacrifice principle and the gain function are introduced in the second section.

[3] In the multidimensional poverty measures the number of broad classes rises to 2x N dimensions.

In the third section we describe twelve poverty measures to be compared in the analysis. They reflect variations on five methods of poverty measurement: the food-intake and share method (three variations), the basic-needs method (representing a combination of the American National Research Council's measure and that of the Canadian Market Basket Measure), the half-median income approach (two variations), the 60%-median income approach (two variations), Yitzhaki's first quintile measure and one absolute poverty measure (with its basket based on the real value of half the median income in 1997). This list is by no means exhaustive: A necessary requirement for including a specific poverty definition in the analysis is the ability to calculate food-gaps. This necessarily limits the poverty measures to those that are calculable in the expenditure survey.

In the fourth section we apply the method to the Israeli expenditure survey for 2009 by calculating the gain function for each poverty measure and comparing the results. Conclusions are drawn in the final section.

2. A gain function for poverty measures and the sacrifice of basic food needs

In this section we develop four gain functions for any of the compatible[4] poverty measures - based for each poverty measure respectively on headcounts, gaps and squared gaps from food poverty and finally on the squared gap, adjusted for deviations of the poverty measure's specific gap from its related food-gap.

People find it difficult to agree on a poverty definition, but they will probably find it easier to rank any two families' poverty situation, if each family's cost of vital food needs is known and if we can show convincingly, that one of the families has to sacrifice more of its vital food needs in order to fulfill other needs, than another family. Of course we need to ascertain that the vital food needs are properly measured. The economic stress of a household is assumed to become more severe, the higher the sacrifice of vital food needs, thus suggesting that they act as a least common denominator for indicating economic stress, to which observers can subscribe even if their social convictions differ widely (which may be reflected in the competing poverty measures), since a continued lack of food is eventually lethal.

A further advantage of food expenditure as a measure of socio-economic stress is its technical property of high divisibility. Food sacrifice can be split into small amounts,

[4] In our context a poverty measure is compatible if a vital food-gap can be calculated. In other words, in addition to the information necessary to calculate the specific poverty measure, we also need information on food expenditure in our data base.

thus making it an expenditure item that allows for a very gradual substitution, when compared to other more bulky vital expenditures, such as the payment of the housing rent. A family in need of paying the rent or the energy bill in winter that has to cut more deeply into its vital food consumption will thus be considered poorer as those who are considered poor by some definition but report a smaller food-sacrifice. Such substitution is of course limited to the food subsistence level, which is considerably below the adequate food norm. If the income falls below the cost of food subsistence, the family will probably opt for becoming homeless in order to devote any income for food only. The combined characteristics of its prime importance as a basic good and its divisibility make the gap of vital food needs a particularly convenient, though extremely conservative indicator for socio-economic stress.[5]

Specifically we assume that genuine poverty is positively related to the sacrifice of vital food expenditure. The maintained hypothesis is that the better this correlation or relationship is for a given poverty measure, the more genuine is that specific poverty definition compared to other definitions.

2.1 An ordering of households by poverty definitions and vital food needs

Let there be *i* households to be allocated to the poor or non-poor for each of the *j* poverty definitions, for each of which a specific poverty-line z^j and resource constraint x_i^j are defined. Furthermore a food poverty-line, z_i^F, defined individually for each household, depending on the household's gender- and age-composition, is compared to the household's actual food expenditure, f_i. The ranking method requires each household in the sample to have an ordering over the variable to be compared, e.g. the headcount or the gap for each poverty definition.

[5] An argument against this indicator may be that people suffering from anorexia (obesity) may wrongly be associated respectively with the poor (non-poor), since their actual food consumption may fall short of (exceed) the food norm. This bias may be aggravated in an empirical application the more frequent such anomalies in food consumption are in the population. The empirical relevance of such anomalies is probably low, since the typical expenditure survey is too small to capture such idiosyncrasies. The problem of misspecification of the obese may be a more serious drawback, since poverty and obesity are often positively correlated. In our empirical section below we propose a correction to this problem in our empirical implementation.

$$P_i^{j,f} = p\left(x_i^j, z_i^j, f_i, z_i^F\right) = \begin{cases} if\ P_i^j\left(x_i^j < z_j\right)\ and\ f_i < z_i^F), then\ P_i^j = TP_i^j \\ if\ P_i^j\left(x_i^j < z_j\right)\ and\ f_i \geq z_i^F), then\ P_i^j = FP_i^j \\ if\ P_i^j\left(x_i^j \geq z_j\right)\ and\ f_i \geq z_i^F), then\ P_i^j = TN_i^j \\ if\ P_i^j\left(x_i^j \geq z_j\right)\ and\ f_i < z_i^F), then\ P_i^j = FN_i^j \end{cases}$$

for all households *i, i = 1….N* and poverty definitions *j, j= 1….J,* where TP indicates a 'true positive' outcome ('the household is both food poor and poor according to poverty definition j), FP indicated a 'false positive' outcome (i.e. food non-poor but poor according to poverty definition j). TN means 'true negative', i.e. non-poor by both definitions, and FN stands for the 'false negative' case.

According to these orderings poverty measure *l* will be 'g^δ −preferred' to the measure *k* if the following holds:

$$P_i^{l,f} \succ_{g^\delta} P_i^{k,f}$$

$$if$$

$$\frac{1}{N}\sum\nolimits_i^N g_{i,l}^\delta (TP_i^l + TN_i^l - FP_i^l - FN_i^l)$$

$$>$$

$$\frac{1}{N}\sum\nolimits_i^N g_{i,k}^\delta (TP_i^k + TN_i^k - FP_i^k - FN_i^k)$$

$$j = 1 \ldots\ldots J; k, l \in j; k \neq l\ .$$

where $g_i^\delta = (z_i^F - f_i)/z_i^F$ and $\delta \geq 0$. For $\delta = 0$ the preference rule is a headcount measure, for $\delta = 1$ the ordering will be based on the average food-gap. Similarly to the FGT poverty measure with a parameter of $\delta > 1$ the powered income gap weighs the deviations from the food line by their severity.

In our empirical application we assume that δ = 2, as customary in much of the poverty research using the FGT method.

However even the squared food-gap ignores information that can be useful for a more sophisticated comparison: for most poverty measures[6] a gap between the specific poverty line and the actual value can be calculated, reflecting the depth of poverty according to that poverty definition.

[6] In the present analysis only for the multidimensional poverty measure a gap could not be calculated. Thus we had to exclude it's comparison in this section.

A further refinement of the quality measure can thus be achieved by comparing not only the state of poverty as reflected in the powered food gap but also by measuring the deviation of the poverty definition's gap from the food-gap (figure 1). In the case of the adjusted food-gap to the power of δ > 1, $g_i^{\delta^{adj}}$ the preference relationship will be of the following form:

$$P_i^{l,f} \succ_{g_i^{\delta^{adj}}} P_i^{k,f}$$

$$if$$

$$\frac{1}{N}\sum_i^N g_{i,l}^{\delta\ adj}(TP_i^l + TN_i^l - FP_i^l - FN_i^l)$$

$$>$$

$$\tfrac{1}{N}\textstyle\sum_i^N g_{i,k}^{\delta\ adj}(TP_i^k + TN_i^k - FP_i^k - FN_i^k),$$

where

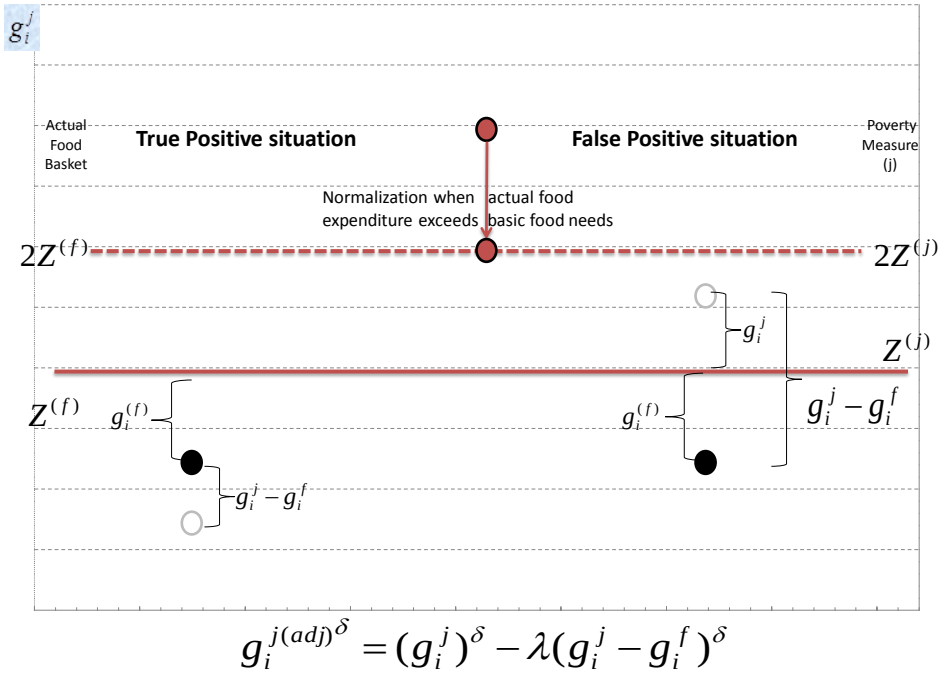
$$g_{i,j}^{\delta\ adj} = {g_{i,j}}^{\delta} - \lambda(g_i^j - g_i^f)^{\delta},$$

$$\text{where } j = 1 \ldots . J;\ k, l \in j, k \neq l\ ;\ 0 < \lambda \leq 1.$$

Adjusted this way a given poverty measure will be preferred to another measure according to the headcount, weighted by the squared food-gap, adjusted for the extent of each household's deviation of the specific poverty definition's gap to the power of δ from its food-gap. The partial adjustment coefficient λ allows for the control of the desired degree of adjustment.

As can be seen from figure 1, for practical purposes we limit the accepted deviations from the food-norm (of the food expenditure of those who are not food-poor) to 100% in order to achieve symmetry with the food-poor, whose deviations are limited by a maximal 100% deviation.

Figure 1: A gain function with the food gap adjusted for the deviation of the poverty definition's gap from the food gap



3. Poverty measures compared – the identification of the poor

A poor household in some statistical survey is typically identified by a vector of characteristics x_i, defining the household's well-being. A household positioned below some defined minimum level is considered poor. The vector x_i may reflect a specific set of variables such as expenditure of goods and services, and/or a set of variables reflecting resources such as income. Poverty definitions based on Sen's capability approach or on some definition of deprivation are more demanding, by including dimensions of functionings and capabilities. The difference between the different approaches is referred to as the issue of identification (Sen and Foster, 1997). The process of identification of the poverty status may be based on a one-dimensional or a multi-dimensional framework. Further distinctions relate to the way the poverty line and/or the resource constraint are adjusted to changes in prices or income.

3.1 One-dimensional poverty measures

For example, in the case of the well-known relative (income or consumption) poverty measure, the approach is one-dimensional. The poverty measure is restricted to some variable of monetary income or expenditure. After choosing the relevant variable, say, the equivalized net monetary income or expenditure, a specific statistic is drawn from

this one-dimensional distribution of a given household survey, say, half or 60% of the mean or the median.

Another example of a single dimensionality is the absolute poverty measure, based on some variable. A poverty measure is considered absolute if the definition is fixed or anchored at some point in time and space, implying that the components (say some budget or commodity basket) are updated over time and space to account for changes in prices but not for changes in the standard of living.[7] This definition uses even less information than in the relative approach. The value of the chosen variable is calculated for each household included in the survey over time and compared to the absolute poverty line. A household, for whom the defined variable is found to be below the chosen poverty line, is considered to be living in poverty.

Empirical examples of such absolute poverty measures are the official US definition (Orshansky, 1959), the World Bank's One-Dollar-a-day measure etc.[8]

Empirically the degree of "absoluteness" could be made less discontinuous, if the point of reference of the poverty line is adjusted from time to time to the general standard of living.

3.1.1 Absolute (anchored) poverty

There are many possible absolute poverty measures available. Probably the best known official absolute poverty measure is the one used in the USA since the Johnson Administration's "Great War on Poverty" in 1964.[9] That measure sets the poverty line at the budget derived by multiplying the minimum food requirement for a standard (4 person) family by 3, reflecting the fact, that in the early 1960's, when the measure was first calculated by Mollie Orshansky, the average food expenditure was about one third of such a household's total consumption expenditure. Another widely used absolute measure is the "one-dollar-a-day" measure, adjusted for purchasing power parity, of the World Bank, or varieties of them for measuring poverty in poor countries.

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[7] This distinction should not be confused with the more general statement requiring a consistent poverty measure to be absolute in the space of capabilities (Sen, 1985) or utility (Ravallion, 1998). This must be true for any poverty measure. In the spheres of commodities or income, such poverty definitions may well be relative.

[8] This statement should be qualified, since the introduction of an equivalence scale can potentially add important dimensions to the poverty definition, since it is often based on outside information, such as the food share in expenditures. In some cases it draws on even more sophisticated information (see Buhmann et al, 1988, Jones and O'Donnell, 1995, Saidi and Burkhardt, 2003).

[9] See Fischer Gordon (1997).

An absolute poverty line used in the Israeli context equals half the net equivalized cash income, frozen at its real value of that sum in 1997.[10] This measure has frequently been published in the Bank of Israel Annual Reports and was also proposed by the Bank to be included as a possible poverty measure in the official commission on poverty definitions.[11] It was also promoted in the Israeli context by Stanley Fischer (2005), Israel's Governor of the Central Bank.

3.1.2 Relative income or expenditure poverty: The x-percentile measure

Yitzhaki (2002) argues in favor of decomposing the Gini- index of income inequality at an exogenously given percentile of the income or expenditure distribution, identifying those below the cutoff percentile as poor. In the empirical illustration Yitzhaki applies the poverty line to the 20^{th} percentile of the distribution of consumer expenditure rather than income. His measure identifies poverty as a constant share of the total population over time. The suggested poverty line could be applied to some other Gini-index, such as of educational achievements, some health variable or, so it seems, also to a multidimensional Gini-index (op.cit. p.65).

3.1.3 The relative x%-median or average income or expenditure measure

Probably the most popular poverty measure for advanced countries is the relative approach based on the definition of the poverty line as 50%-median equivalized household cash-income. This measure has been chosen by the OECD for monitoring poverty in its member countries. The equivalence scale applied by the OECD in recent years has been the square root of household size. The income measure typically refers to cash income but could also be extended to include near-cash income or income in kind.

3.2 Poverty measures using more than one dimension

Examples of poverty measures using more than one dimension are the definition used by an expert group gathered at the National Research Council of the National Academy of Science (henceforth NAS), which combines information on income and expenditure as explained in Citro and Michael, eds. (1995), and the Canadian Market Basket Measure (MBM), which is similar in spirit to the NAS (see Hatfield, 2002) but

[10] The year 1997 was chosen by convenience, since in that year the Israeli income and expenditure survey were unified and underwent significant changes.
[11] See Inter-Ministerial Commission on poverty definitions ("Yitzhaki report").

differs importantly in that it makes use of nutritionally determined adequate food basket. Another important expenditure-based measure, developed by Ravallion (1994) is called the Food-Energy-Intake and Share (FES). A similar measure is also discussed and empirically analyzed in Anker (2006).

3.2.1 The MBM/NRC approach

Food-Clothing-Shelter (FCS): The food poverty-line is set normatively by nutritional recommendations for each family's age-gender composition.[12] The normative nature of the MBM food expenditure is an advantage over its relativity in the NRC approach, since the state of information today allows quite accurate and environmentally coordinated assessment of basic food expenses. The poverty line is set according to the 30th to the 35th percentile of the non-food goods which was shown to be approximately 80% of the median food basket (Citro and Michael, 1995).[13] The non-food component is made up of basic expenditures such as shelter, clothing and footwear, transportation, education and a small incremental multiplier for miscellaneous personal expenses.

Medical expenses: The NAS committee avoided the inclusion of medical expenses and expenses for education in the poverty line.[14] However Gottlieb and Manor, 2005, (henceforth GM) included the average out-of-pocket expense on health, not covered by the basic health insurance. GM added the average out-of-pocket expenditure to the enhanced FCS poverty line and also deducted excessive out-of pocket health expenditure from the income source variable, thus emphasizing its existential importance.[15]

An updated and improved version can be found in Gottlieb and Fruman (2010).

[12] The Israeli food basket was calculated by the team of Nitsan-Kaluski at the Ministry of Health only for year 2002. Gottlieb and Manor (2005) and also Gottlieb and Fruman (2010) updated the basket for recent years using the nutritional values of the base year and adjusted it by the relevant price changes.

[13] The selection of percentiles 30 to 35 was made by the NAS committee, among other things, in reliance on family-budget research by Renwick and Bergmann (1993), which found expenses in these percentiles to represent about 80% of the median expenditure. Tests regarding the American economy showed such expenses to to fall into the range of 78 to 83 percent of the median. Calculations by Gottlieb and Manor (2005) for Israel in 1997 to 2002 yielded similar results.

[14] See Iceland (2005).

[15] Typically one would add common basic health components to the basic consumption basket forming the poverty line. However, in order not to inflate the basic basket by items that are not widely used, but are nevertheless of existential importance to the specific sick person spending on them, we deduct such idiosyncratic but basic expenditures from total income sources, since they are not available for the basic enhanced FCS expenditures.

Income sources: The second dimension introduces the sources of income, thus addressing the question of "who is poor". The NAS includes all incomes i.e. in contrast to the approach, restricted to net monetary income, the NAS/MBM in GM also includes income in kind.[16] In order to calculate the net income disposable for the purchase of the basic enhanced FCS basket, the share of private basic expenses on health is deducted from the total income from all sources, if they deviate from average private expenses on health.[17]

Work expenses: The cost of transportation to and from work for working single parents or for couples with small children, where both husband and spouse are working, is also deducted in order to distinguish their poverty situation from that of families with a similar financial income, but in which one of the parents stays at home to take care of the small children.

3.2.2 The FES approach

Identifying the poor – the poverty line and the income resource constraint

3.2.2.1 The food component of the poverty line

In the Food-Energy-Intake and Share (FES) approach the poverty line is calculated based on the cost of a basket of two types of goods and services – food and non-food. The food component is calculated, based on a study, which estimated the cost of an adequate diet of nutritional needs. This may therefore be viewed as a normatively required food basket – in short the food norm (z_i^F). The diet of the food norm can be calculated in detail for gender and age groups and should be easily accessible and reasonably cheap on the market.

3.2.2.2 The non-food component

In contrast to typical poverty measures based on expenditure surveys Ravallion avoids the tedious enumeration of consumption items that should be considered as basic consumption and scrutinizes instead two crucial points of interest on the budgetary expansion path of household expenditure. In order to determine the poverty line of severe poverty of a conservatively estimated lowest level of expenditure on non-food necessities he focuses on the size of the food sacrifice of a household which

[16] Due to lack of detailed information regarding incomes in kind of public services, only private incomes in kind were included, mainly the non-cash income derived from accommodation in a privately owned apartment.

[17] Iceland (op.cit.), whose paper was published after GM suggested a similar calculation for the United States.

commands just the level of income, sufficient for the purchase of the normative food-basket. Obviously, since the minimum food necessity is considered vital, the household's choice to spend nevertheless some income on non-food items, by sacrificing some vital food expenditure, implies, by revealed preference, that the chosen non-food items are considered by this household to be even more vital - no matter what their composition is - than the objectively determined vitality of the food expenditure.

A very conservative poverty line would thus be the sum of the adequate food consumption (z_i^{F1}) and this low level of essential non-food expenditure (z_i^{NFL}). However, obviously, at such a severe budget constraint, faced by the household, this cannot be considered to be the poverty line, since the food sacrifice that enabled the purchase of the even more vital non-food items indicates that there is still a considerable amount of vital non-food expenditure that has been foregone and should be added, for the calculation of an adequate minimum level of non-food consumption. Just as there is a lowest limit of minimal non-food consumption there must also be some upper limit for non-food expenditure (z_i^{NFU}). Ravallion sets it at the level at which the family's actual food expenditure and the food norm coincide, since at that point we are sure that the families are not "food-poor".[18]

Obviously, each type of household will have different pairs of poles, depending on its age and gender composition. Therefore this poverty measure creates a range of non-food poverty lines over the various household types.

3.2.2.3 The calculation of the poverty status

The household's poverty status is derived from comparing this poverty line to the household's resource constraint. Another possibility is to compare it to actual consumption, thus giving a more permanent interpretation of poverty.[19]

Ravallion calculates two poverty lines – a low poverty line of severe poverty (z_{Li}) and a higher one of more moderate poverty (z_{Ui}) - from a regression of the actual food share (s_i) on the logarithm of the ratio of total expenditure to the food norm:

[18] Microeconomic theory suggests that at this point the relative marginal utilities of food and non-food consumption should be equal the relative price of food and non-food.

[19] This is due to the fact that consumption is more stable than income, as stated in Friedman's permanent income hypothesis and in the life cycle hypothesis of Ando and Modigliani.

$$s_i = \alpha + \beta \log(\frac{x_i}{z_i^F}) + \varepsilon_i$$

At the lower non-food poverty line we assume that the household's income equals precisely the food norm, therefore at that point $s_i = \alpha$ and thus the non-food share of the lower poverty line is z_i^{NFL}=α*x_i^1 and since at that point by definition $x_i^1 = z_i^{F1}$ the poverty line at the lower level can be written

$$z_{Li} = z_i^{F1} + z_i^{NF1} = z_i^{F1} + (z_i^{F1} - food_i) = 2z_i^F - \alpha z_i^F = z_i^F(2-\alpha)$$

At the upper non-food poverty line we assume that the household's food expenditure equals precisely the food norm, therefore at that point s*=z^F/x_i. We can then calculate the food share for which the following equation is satisfied:

$$s^* = \alpha + \beta \log(1/s^*)$$

This equation can be solved approximately for *s** by the following algorithm for t iterations (figure 2):

$$s_t^* = s_{t-1}^* - (s_{t-1}^* + \beta \log(s_{t-1}^*) - \alpha)/(1 + \beta / s_{t-1}^*)$$

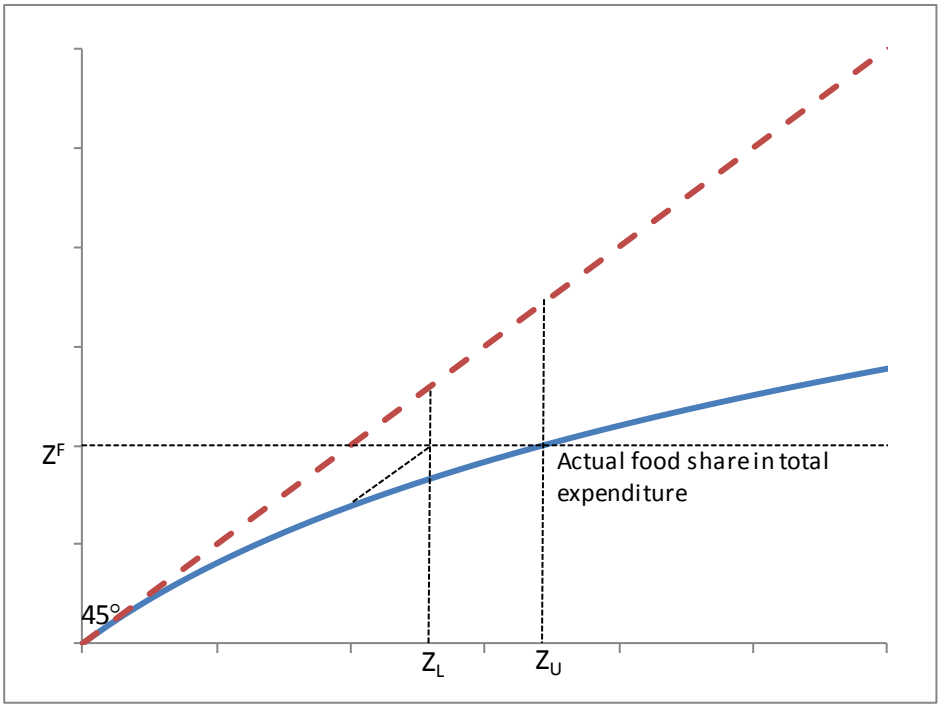
The upper non-food poverty line can then be calculated as following:

$$z_i^{NFU} = z_i^U - z_i^F = z_i^F(\frac{1-s^*}{s^*})$$

We define the poverty line to be the sum of the food norm and the average of the lower and upper bound of the non-food component.

$$z_i = z_i^F + 0.5*(z_i^{NFL} + z_i^{NFU})$$

Figure 2: The food share line and the two poverty lines Z_L and Z_U



3.2.2.4 The income resource constraint

In Ravallion (1994) the treatment of the resource constraint is left to the researcher's discretion. Our resource constraint includes all income sources, net of taxes, social security and health contributions. It includes both cash income and imputed income, as collected by the Israeli Central Bureau of Statistics. The major components are income from work, from capital and from social security payments. Income is imputed for home owners who live in their own home, for families who live in a subsidized dwelling or a dwelling paid by someone else etc., for the car owner's use of the car, for the use of a company car.[20]

3.2.3 The Multidimensional approach

A number of pioneering articles treating Israeli poverty in a multidimensional framework were written by Jacques Silber in collaboration with Deutsch (2007), Sorin (2006) and Deutsch and Israeli (2007). Unfortunately, being based on the 1995 CBS

[20] A professional committee is in the process of improving the data collection of such subsidies in the Israeli expenditure survey. At this stage the calculations do not include a deduction from net income of the cost of going to work. This cost reflects transportation costs and the cost of taking care of the small children in the family, in the case of both parents going to work or if the worker is a single parent. Such adjustments are necessary for arriving at an income definition that can be truly interpreted as reflecting the income that is disposable for the consumption of the basic basket of reflecting a minimum standard of living.

census data, rather than on the yearly expenditure surveys and concentrating on expenditures on durable goods, these analyses lack data on food expenditure. Therefore their model could not be applied to the present framework.[21] Gottlieb and Haron (2011) calculated multidimensional poverty in a framework of social deprivation, including four dimensions: (1) current and durable goods consumption, (2) education as captured by years of schooling, (3) employment and (4) dwelling conditions. The material deprivation, i.e. the consumption aspect, was defined as following: Consumption of non-durables included those groups of goods and services consumed by at least 50% of the households. There turned out to be 28 such groups. A family that did not consume any of a specific group received a value of 1, and 0 otherwise. Following the model of Desai and Shah (1988), if the average of the binary results for a household, weighted by each group's relative frequency over all households, exceeded 0.1, that household was considered deprived in terms of non-durable goods. 69% of the households were deprived by only this dimension. As to the durable goods component, the question in the survey is about the use of such a good in the household. If the good is in not in use in a specific household despite its presence in more than 50% of the households, this household is considered deprived. The weighted average of 75.6% of all households exceeded zero, thus implying some deprivation. 57.3% of households were found to suffer from social deprivation in their consumption of goods and services. After allowing for differences in tastes[22] their percentage shrank to 37.1%.

Educational social deprivation (less than 12 years of schooling for adults born after 1949 (as required by the legal minimum) or less than 8 years for older persons, occurs in 25.3 households.

Social deprivation in the labour market was defined both on counts of unemployment, non-employment and on earnings below the minimum wage. People in pension age were counted as deprived if they didn't have an income from work pension. 29.1% of the adults were found to be socially deprived.

A household with more than one person per room was considered to live in overcrowded conditions and thus to be socially deprived in this context. Considering

[21] Furthermore it should be noted that all the mentioned papers treat multidimensionality strictly within the durable goods consumption.

[22] If a household had an equivalized income equal or higher than the median income, the deprivation was deemed to reflect the tastes of the household. This is particularly important for the Jewish ultraorthodox society in which – for ideological reasons - many households do not own a television set, personal computer or internet connection.

couples living in a studio this may cause a slight exaggeration, however this effect turned out to be negligible. 25% were found to be socially deprived in this aspect.

4. Empirical results

The calculations are based on the Israeli survey of income and expenditure for the year 2009 and on the food norm as suggested by the Israeli Ministry of Health. A sensitivity test of the results was done for the years 1997 – 2008.

4.1 The food norm

The expenditure on the food norm was calculated in a joint venture by the food security department in the Ministry of Health and the Central Bureau of Statistics (CBS)[23]. The diet follows the nutritional guidelines of the United States Department of Agriculture (USDA) as reflected in the food pyramid, adjusted where needed to Israeli conditions and is spelled out in table 1. With the addition of a little bit of fat, energy, carbohydrates and sugar a food basket supplying these nutrients (proteins, vitamins and minerals) is considered a healthy diet.

The food items were adapted such as to reflect Israeli food habits, as reported in the MABAT survey, carried out among adults aged 25-64 during 1999 – 2001 by the Ministry of Health. The size of the portions was derived from the USDA's Healthy Eating Pyramid backed up by calculations of the Israeli Ministry of Health's database BINAT of 100 gram of each of 49 nutritional components, yielding a list of 4,500 food items. The CBS provided prices for about 160 basic food items. The food items were then allocated to the six main food categories in table 1.

[23] See Nitzan-Kaluski, 2003.

Table 1: USDA - Daily Reference Intakes (DRI's) by the National Academy of Science, 2003

Age/Gender	Energy	Cereal	Vegetables	Fruits	Milk and dairy products	Meat or Substitutes
Children 2-3 years*	1300	6.0	3.0	2.0	2.0	2.0
Children 4-6 years	1800	7.0	3.3	2.3	2.0	2.1
Children 7-10 years	2000	7.8	3.7	2.7	2.0	2.3
Boys 11-14 years	2500	9.9	4.5	3.5	3.0	2.6
Boys 15-18 years	3000	11.0	5.0	4.0	3.0	2.8
Boys 19-24 years	2900	11.0	5.0	4.0	2.0	2.8
Men 25-50 years	2900	11.0	5.0	4.0	3.0	2.8
Men 51 years and more	2300	9.1	4.2	3.2	2.0	2.5
Girls 11-24 years	2200	9.0	4.0	3.0	3.0	2.4
Women 25-50 years	2200	9.0	4.0	3.0	3.0	2.4
Women 51 years and more	1900	7.4	3.5	2.5	2.0	2.2

*The size of the portions was reduced by the Israeli Ministry of Health to 2/3 of the US portions to fit Israeli food habits and health standards.

The cost of the adequate food basket is reported in table 2:

Table 2: The cost of the adequate food basket (NIS, current prices)

Gender and age group	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
child 2-3	328	347	371	380	389	400	411	411	417	437	453	505
child 4-6	348	367	393	402	412	424	436	435	441	462	480	535
child 7-10	374	395	423	433	444	456	469	469	476	498	517	576
male 11-14	456	481	515	527	540	556	571	571	579	606	630	702
male 15-18	515	543	581	595	610	627	645	644	654	684	711	792
male 19-24	515	543	581	595	610	627	645	644	654	684	711	792
male 25-50	456	481	515	527	540	556	571	571	579	606	630	702
male 51+	361	381	408	417	428	440	452	452	459	480	499	626
female 11-24	453	479	512	524	537	552	568	567	576	603	626	698
female 25-50	395	417	446	456	468	481	495	494	501	525	545	607
female 51+	407	429	459	470	482	496	510	509	516	541	561	556

4.2 Comparison of the quality indices[24]

The best result was obtained by the FES expenditure based model. This is not surprising since the food norm, z_i^F, is an integral part of this poverty definition. While this cannot be a conclusion, arising from the research it can be a recommendation. Adding the income resource constraint worsened the results, possibly because income variables are probably less reliable than consumption data. An interesting result is the

[24] For convenience we present the results of the gain function in figures 3 to 5 as percentages of the gain function for true outcomes (TP+TN) only. In figure 6 the same representation would result in negative percentages throughout all measures, though the ranking becomes more clear-cut the higher the partial adjustment coefficient. For expositional convenience we divide the gain function by 10,000 in this figure (vertical axis).

relatively high score of the 60% MBM/NRC median income poverty, which does not use the food norm, since it is an income variable. It does however take account of special non-monetary income components such as the cost of going to work. The household poverty definition is found to rank higher than the poverty by persons. This definition is followed by Yitzhaki's first quintile definition. The Israeli half-median definition appears with a relatively low ranking, but still better than the half-median definition of the OECD. According to the present analysis the OECD's square root equivalence scale, though it may be suitable for international comparisons, seems to fail for countries with a high percentage of large families. Indeed here it scored next to the worst rank.

Figure 3: Gain function – Headcount

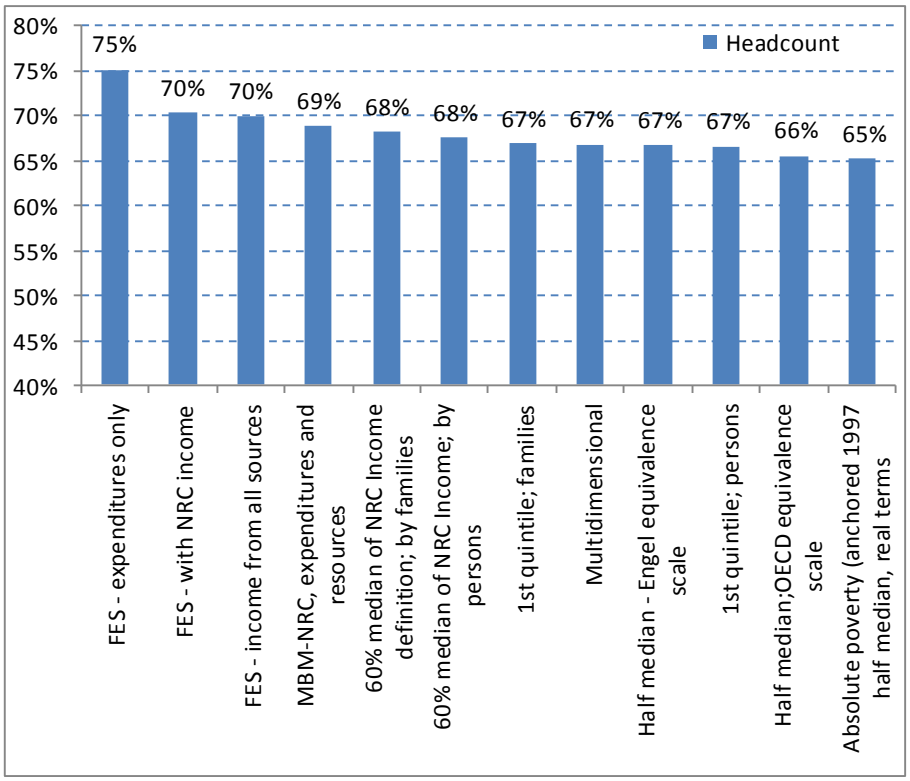


Figure 4: Gain function – Food gap

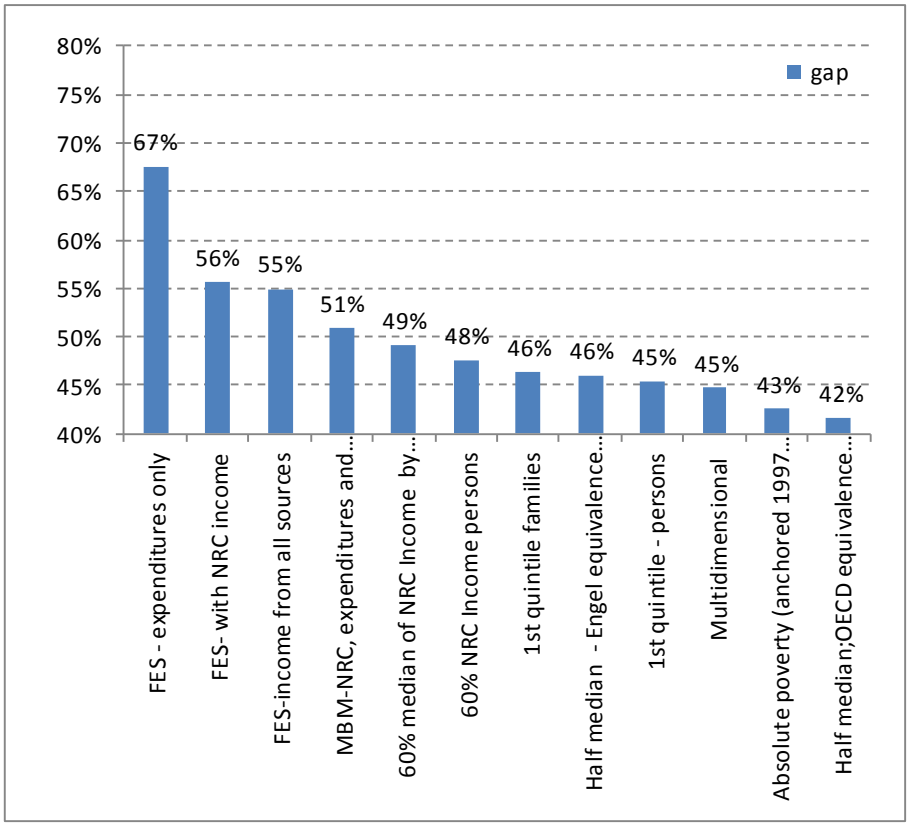


Figure 5: Gain function – Squared food gap

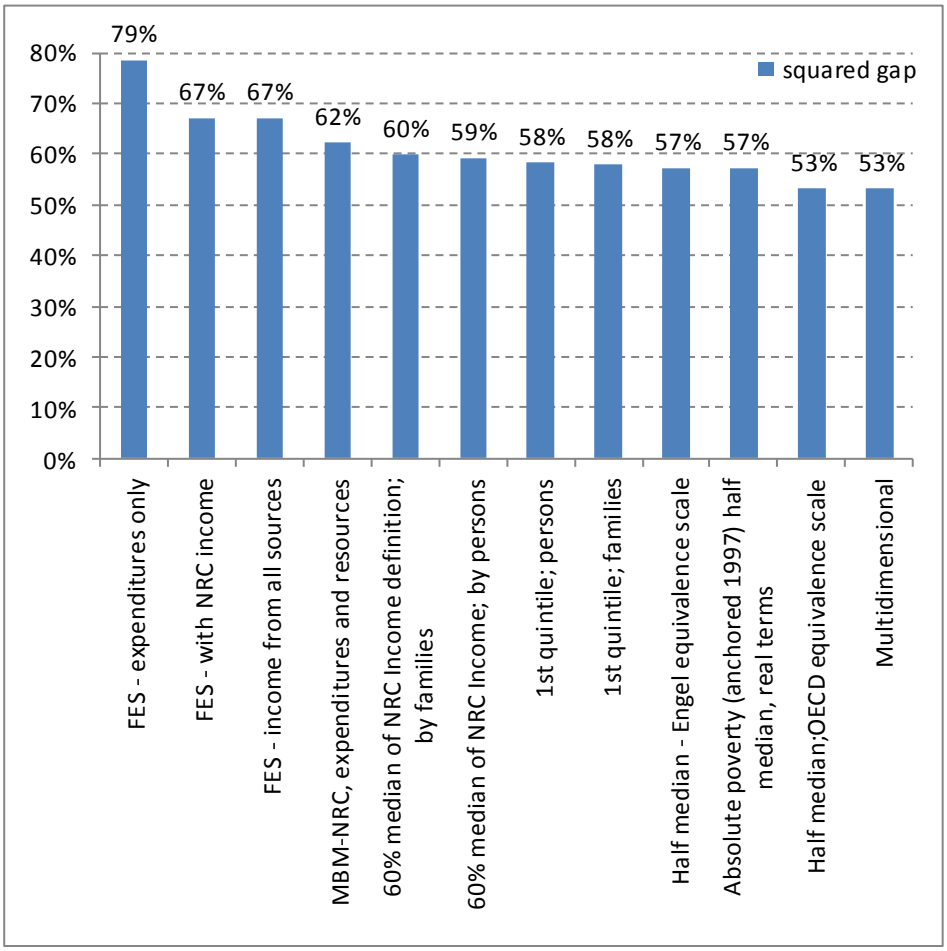
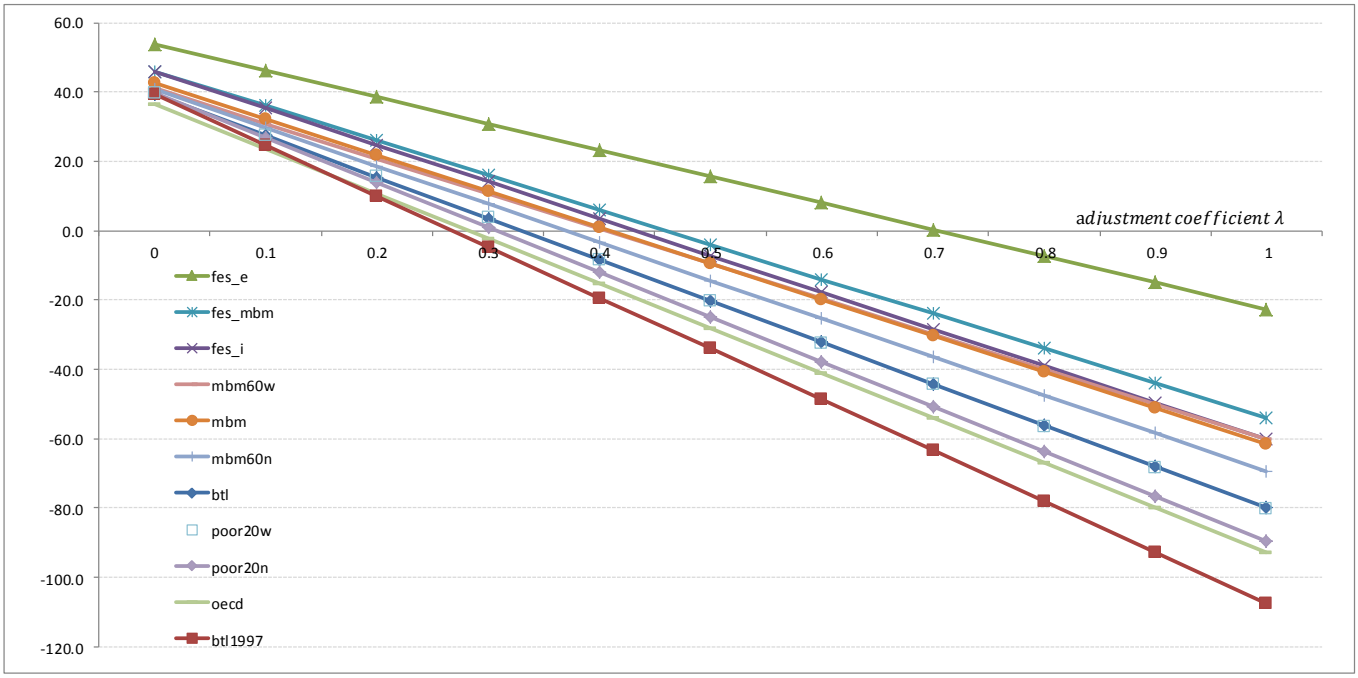


Figure 6: Gain function – Adjusted squared food gap



The absolute poverty measure gets the worst ranking both in the simplest version of the headcount gain function and also in the most sophisticated FGT-oriented version that accounts not only for squared food gaps but also for the adjusted version, which takes into account deviations in the poverty definition's gap from the food gap. In the two other variants its score is among the two lowest.

The relatively low rank of the multidimensional definition is somewhat surprising. This disappointing result may be due to the fact that multidimensional poverty measurement including several dimensions is relatively new in Israeli research and further research may yield better results. Furthermore it should be noted that it was not yet included in the more sophisticated adjusted gain function, although Alkire and Foster (2011) suggest this to be possible.

The best unbiased[25] performance is achieved by the 60% NRC-income poverty definition (income from all sources, with a special treatment of costs of going to work and excessive out-of-pocket health expenditure) as described in Citro and Michael (1995) and adjusted and applied in Gottlieb and Fruman (2010).

5. Concluding remarks

The multitude of available poverty measures can confuse a policy maker who wants to choose rationally among competing poverty measures for the purpose of targeting, monitoring and evaluating a poverty-reduction policy. Rational choice of the identification process (in Sen's terminology) is imperative the greater the need for poverty reduction and the lower the governments' budgets for that purpose are.

Poverty measures may not only differ in the identification of the poor and –as it turns out to be important in this paper, also of the non-poor but also in the evaluation of the households' and the overall poverty severity by the various poverty measures.

This paper proposes the food-gap - the difference between the cost of a household's normative food basket and that of the food basket actually chosen - as an efficient benchmark for ranking the quality of competing poverty measures. The food norm can be objectively calculated from an accessible, adequate nutritious gender- and age-related diet and the actual basket can be obtained from a standard expenditure survey.

[25] As argued above the inclusion of the food norm in a poverty measure arguably creates an advantage for these poverty measures in our framework. Therefore the high score of the 60% NRC income measure is especially interesting, since it suffers from no such bias.

This food-gap is particularly sensitive to the sacrifice a household, exposed to economic stress, has to make in order to acquire essential non-food goods and services. Sensitivity is expected to be high, due to the food-gap being not only a quintessential basic need but also a good that can be substituted continuously, thus allowing for gradual comparison of the degree of stressful situations among households.

We identify a household as being 'truly' poor if its identification of poverty by some poverty measure coincides with food-poverty and vice versa. When a household is identified as being poor by some poverty measure, while its actual food expenditure exceeds the food-norm, i.e. its food-gap being negative, then its poverty status is considered to be less convincing. This metric allows for a cardinal ranking of alternative poverty measures, with the poverty measure with a higher score of hits being hypothesized as more qualitative than others. A more sophisticated measure compares the various poverty definitions by an FGT-like score of squared food-gaps. Rather than counting only successful identifications we create a quality function that not only benefits consistent identifications but also penalizes for inconsistencies.

The best measure is found to be Ravallion's Food Energy Intake and Share measure. While it may be biased, due to its explicit food-gap approach, the 60%-median income measure, based on Citro and Michael's (1995) NRC's resource constraint, ranks high and is devoid of such a bias.

Two final comments are warranted: (1) The reader may get the idea that the authors view food poverty as the ultimate poverty measure, so why not switch to the food-gap? Because the food-gap does operate as a least common denominator for the most conservative social researcher and for the "progressive" researcher, who may view the measure to be one of extreme poverty. We base our argument in favor of the model on the fact, that households react sensitively to the food-gap. This is sufficient, to justify the use of this least common denominator for ranking purposes, without raising it to more than it should represent. (2) Distinctly from the focus axiom in poverty analysis, here the quantitative results of the non-poor are an important concept in the evaluation of the quality of the poverty measures. Though we do not suggest to relieve that axiom in the poverty measures but only in the gain function, one should keep in mind that axioms, by nature, are not proven but only assumed, and may therefore be changed when appropriate.

Appendix 1:

3.1 The food norm

The study was carried out as a joint venture by the Ministry of Health and the Central Bureau of Statistics (CBS)[26]. The diet follows the nutritional guidelines of the United States Department of Agriculture (USDA) as reflected in the food pyramid, adjusted where needed to Israeli conditions and is spelled out in table 1. With the addition of a little bit of fat, energy, carbohydrates and sugar a food basket supplying these nutrients (proteins, vitamins and minerals) is considered a healthy diet.

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years 25-50 Women	2200	9.0	4.0	3.0	3.0	2.4
years and more 51 Women	1900	7.4	3.5	2.5	2.0	2.2

*The size of the portions was reduced by the Israeli Ministry of Health to 2/3 of the US portions to fit Israeli food habits and health standards.

The food items were adapted such as to reflect Israeli food habits, as reported in the MABAT survey, carried out among adults aged 25-64 during 1999 – 2001 by the Ministry of Health. The size of the portions was derived from the USDA's Healthy Eating Pyramid backed up by by the calculations of the Israeli Ministry of Health's database BINAT of 100 gram of each of 49 nutritional components, yielding a list of 4,500 food items. The CBS provided prices for about 160 basic food items. The food items were then allocated to the six main categories in table 1. Table 2 reports on the cost of the adequate food basket:

Table 2: The cost of the adequate food basket (current prices)

[26] See Nitzan-Kaluski, 2003.

Gender and age group	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
child 2-3	328	347	371	380	389	400	411	411	417	437	453	505
child 4-6	348	367	393	402	412	424	436	435	441	462	480	535
child 7-10	374	395	423	433	444	456	469	469	476	498	517	576
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female 11-24	453	479	512	524	537	552	568	567	576	603	626	698
female 25-50	395	417	446	456	468	481	495	494	501	525	545	607
female 51+	407	429	459	470	482	496	510	509	516	541	561	556

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